Studies in Computational Intelligence, Volume 266

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ISBN 978-3-642-04024-5

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Keiichi Horio (Eds.)

Brain-Inspired Information Technology

Springer

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ISBN 978-3-642-04024-5 e-ISBN 978-3-642-04025-2

DOI 10.1007/978-3-642-04025-2

Studies in Computational Intelligence ISSN 1860-949X

Library of Congress Control Number: 2009940421

Typeset & *Cover Design:* Scientific Publishing Services Pvt. Ltd., Chennai, India.

Printed in acid-free paper

9 8 7 6 5 4 3 2 1

springer.com

Preface

Present information systems have huge computational power and are growing day by day. Although their applications distribute various fields, what they can do is rather complimentary what we human can do. Computers can execute complicated calculations or can pick up a literature from a huge database, which we human cannot do. They, however, cannot recognize what a human is doing in a movie or cannot understand what he is talking about, which we human can easily perform. This difference between computer systems and the human brain is due to the difference in algorithms employed for various functions, and also due to the difference in hardware. Our brain works in parallel, that is, executes a huge number of calculations at the same time. Thus, to equip computers with such human like functions, brain-like algorithms and devices are necessary.

One more sticking difference between computer systems and the human brain is in their creation processes. For artificial information systems, we must give instructions how they should work about all possible situations. They cannot do anything in unexpected situations. On the other hand, we humans acquire various behaviors based not only on genetic information but also on post-natal learning. Especially, post-natal learning enables us to behave correctly in genetically unexpected situations, e.g. driving a car or reading/writing letters. And also, the learning can correct mistakes. A behavior that does not fit to a situation changes into another better behavior. Moreover, most animals have the ability of generalization, guessing a correct behavior for an unexperienced situation based on learned relationships between behavior and situation. Rigidity is one of very important characteristics of computer systems, because we need accurate results of calculations or text searches. Adding human-like flexibility by learning or self-organization algorithms makes present computer systems more powerful and usable.

To realize brain-like information technology, we have still not obtained enough knowledge about how our brain works. Brain science has been producing huge amount of data about our brain. However, many keys to understand our brain function, such as mechanisms of memory, learning, recognition, and etc., are still in a fog of complexity. Some researches intend to apply the data on the development of information system, and others outputs fragments of knowledge useful for constructing information technology, which diffuses and drifts in the sea of knowledge about our brain. Thus technological development of brain-like information system and scientific brain research are necessary to interact to pick up useful fragments of the knowledge or to inspire each other.

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